

Saharan dust aerosols as atmospheric ice nuclei (July 28-29) in CRYSTAL-FACE

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Summary

- The CRYSTAL-FACE experiment was affected by African dust aerosols
- Dust particles are effective ice nuclei, this study providing some of the first confirmatory data at low temperatures
- It will be interesting to study cloud effects

Research goal: What is the fundamental role of ice formation on atmospheric aerosols in determining the microphysical composition of anvil cirrus?

Use: Continuous flow diffusion chamber (CFDC) – Poster 33 by Rogers et al.

Temperature -10 to -65°C

Humidity ice saturation to ~80% SSw

Sample Flow 1 LPM

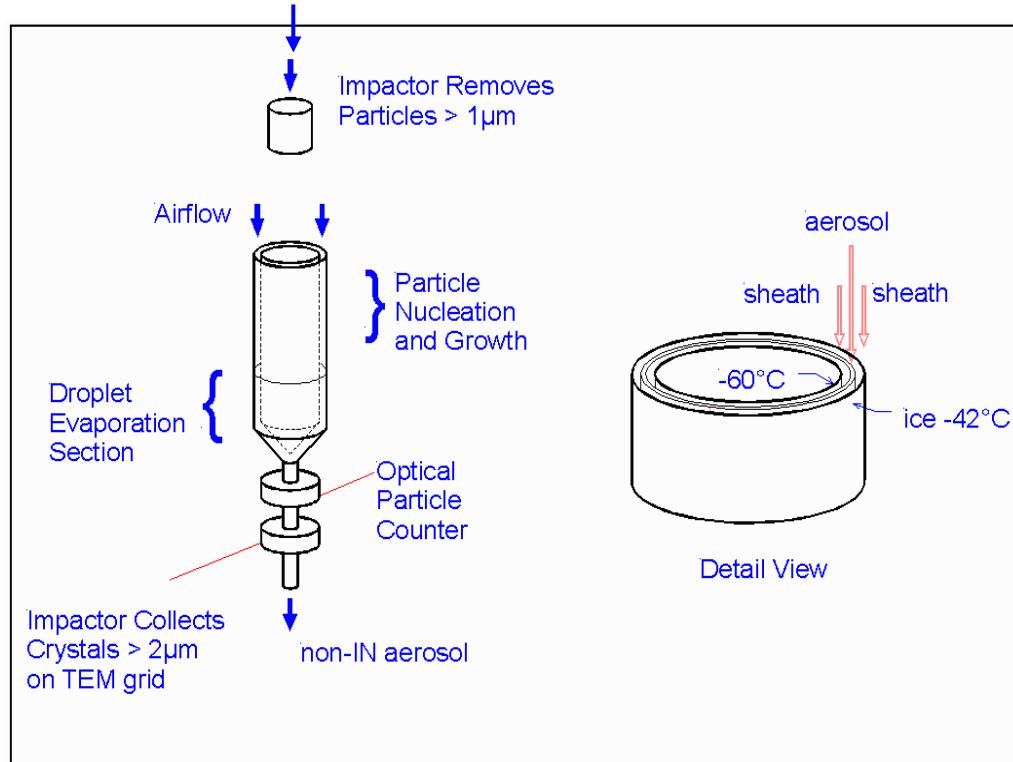
Total Flow 10 LPM

Response Time ~1 second

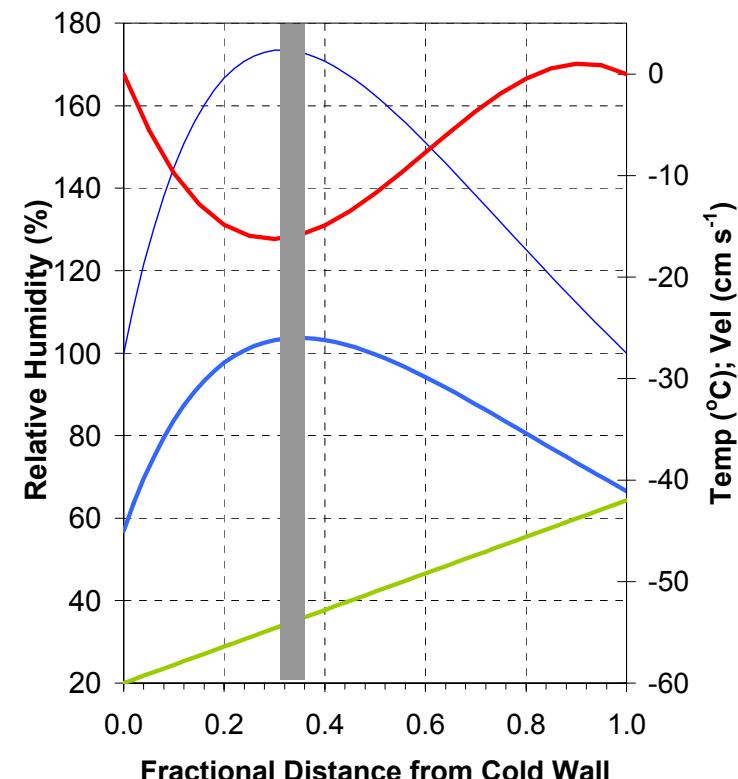
Ice Nucleus (crystal) detection based on OPC size

Collect IN particles (crystals) with impactor at outlet

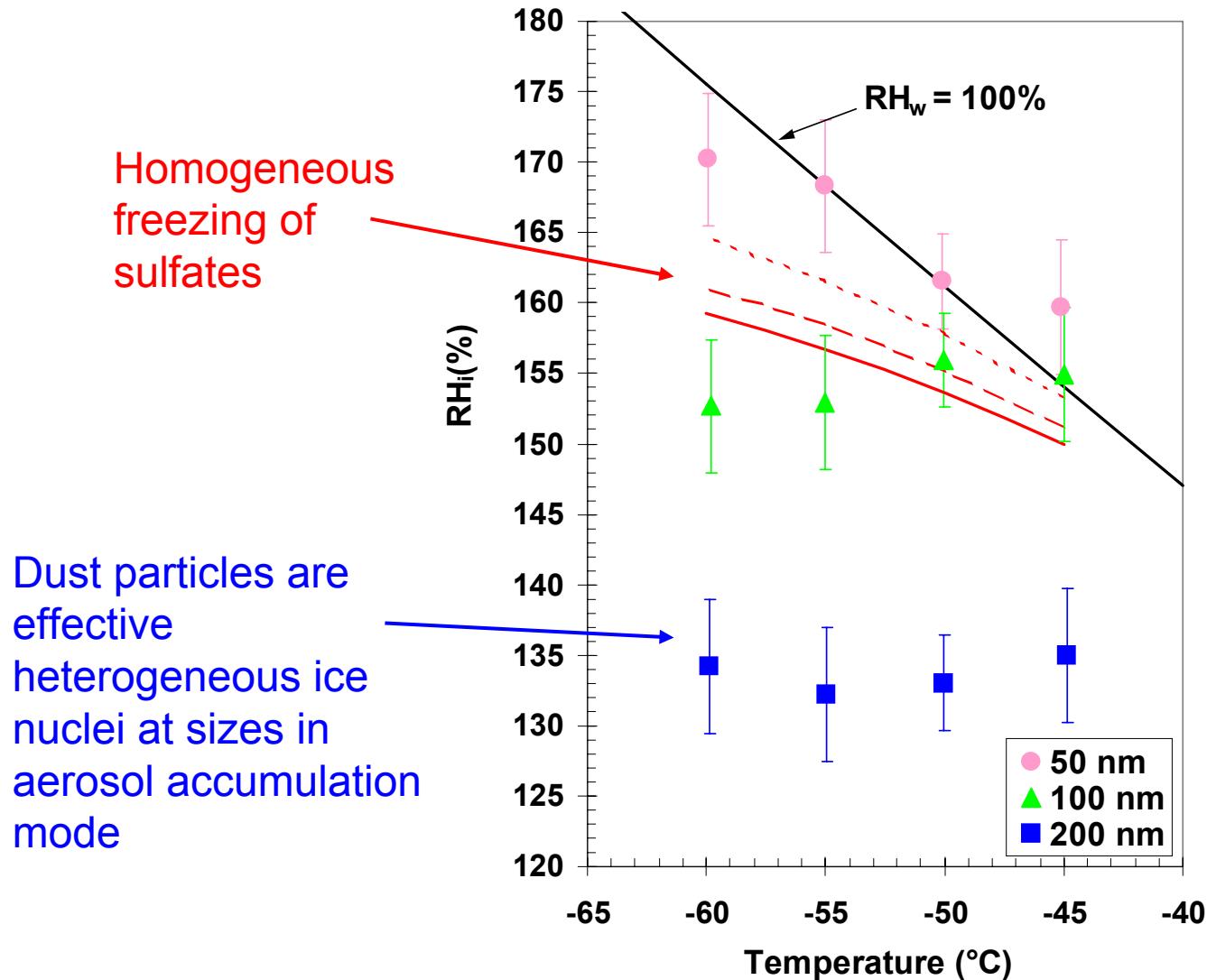
Ambient inlet or CVI



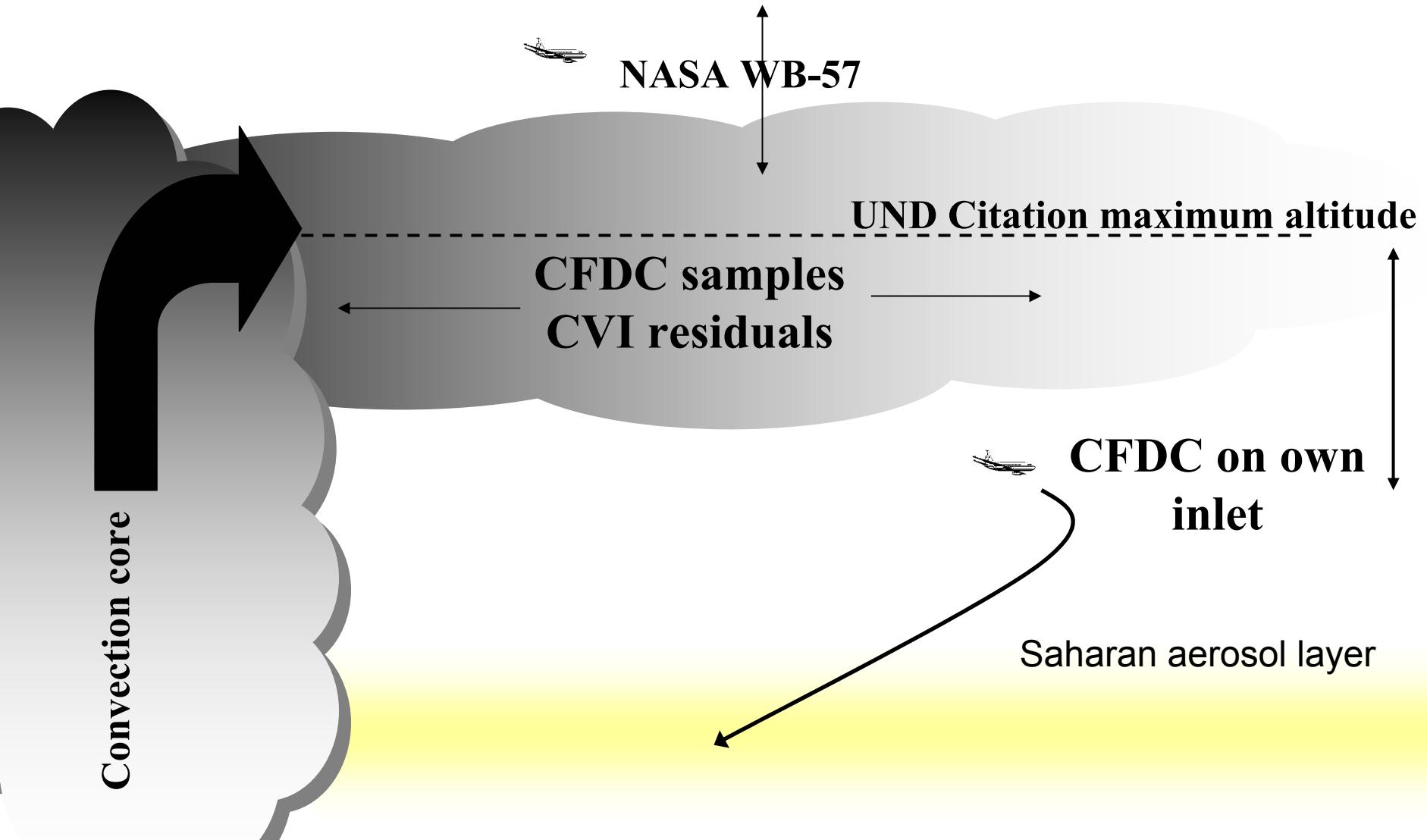
— RHw(%) — RHi(%) — Tx(C) — Vel. (cm/s)



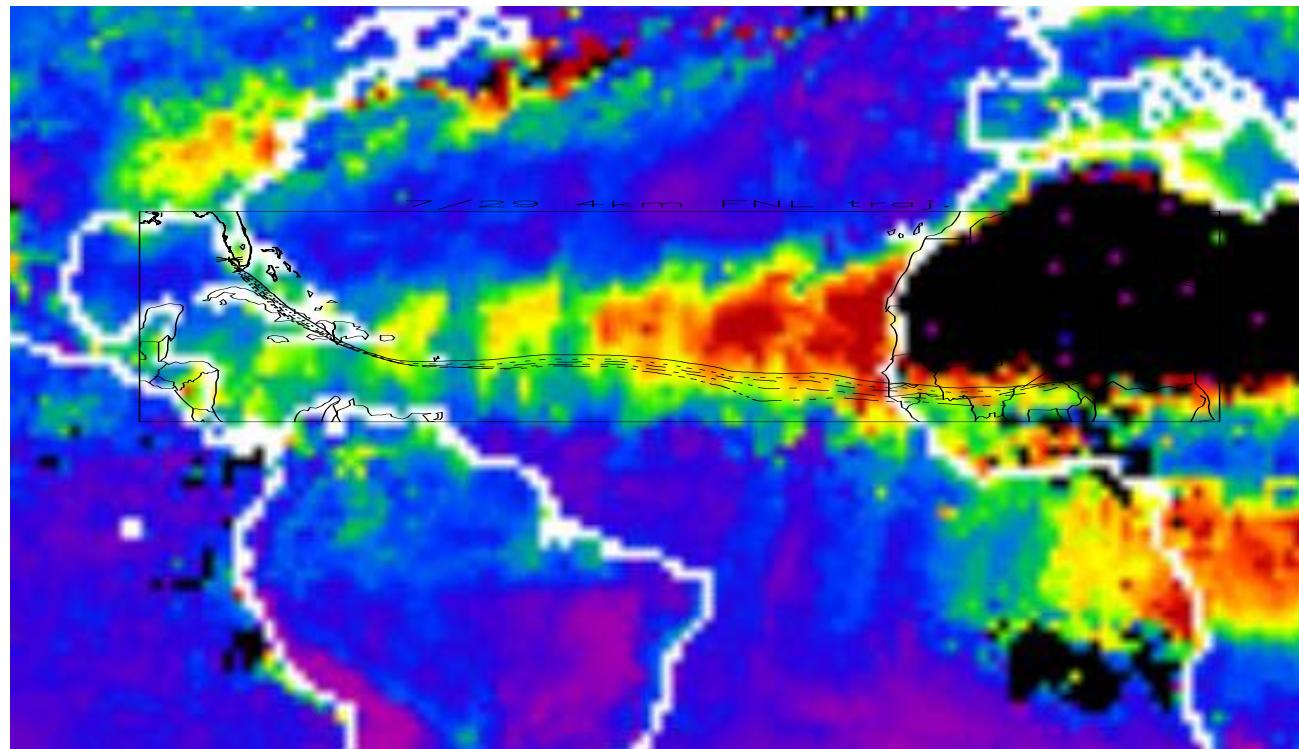
Lab studies of ice nucleation by “certified” Asian dust aerosols (C. Archuleta – CSU)



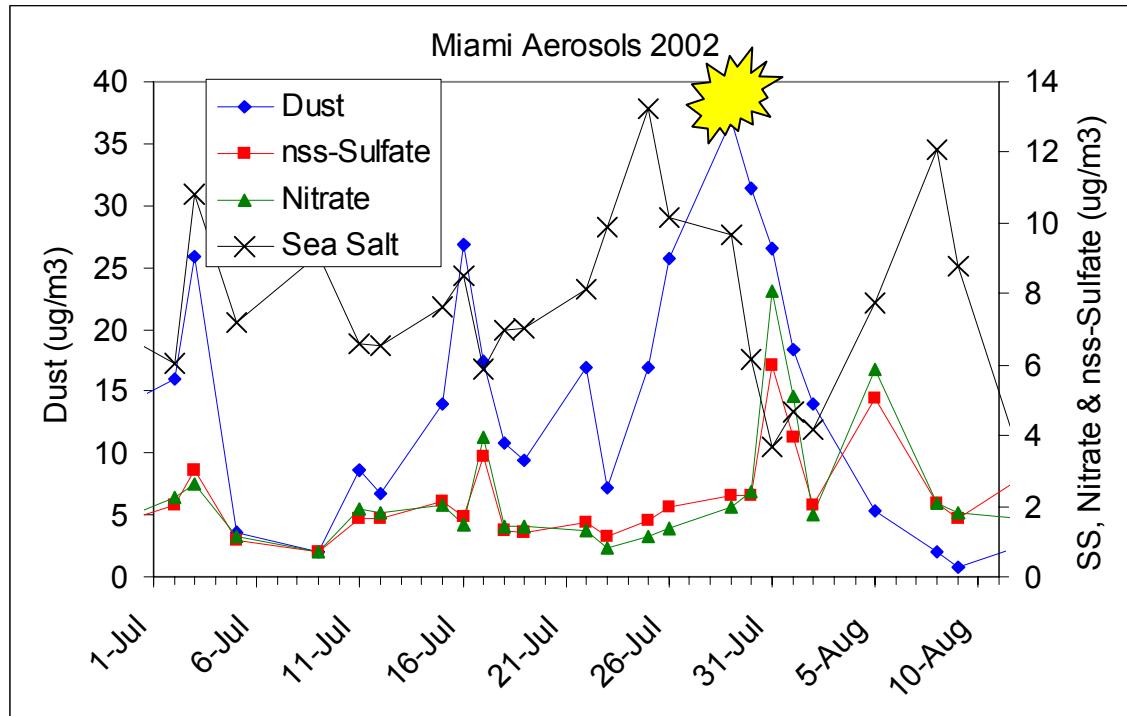
NASA CRYSTAL-FACE sampling in and around convectively driven cirrus



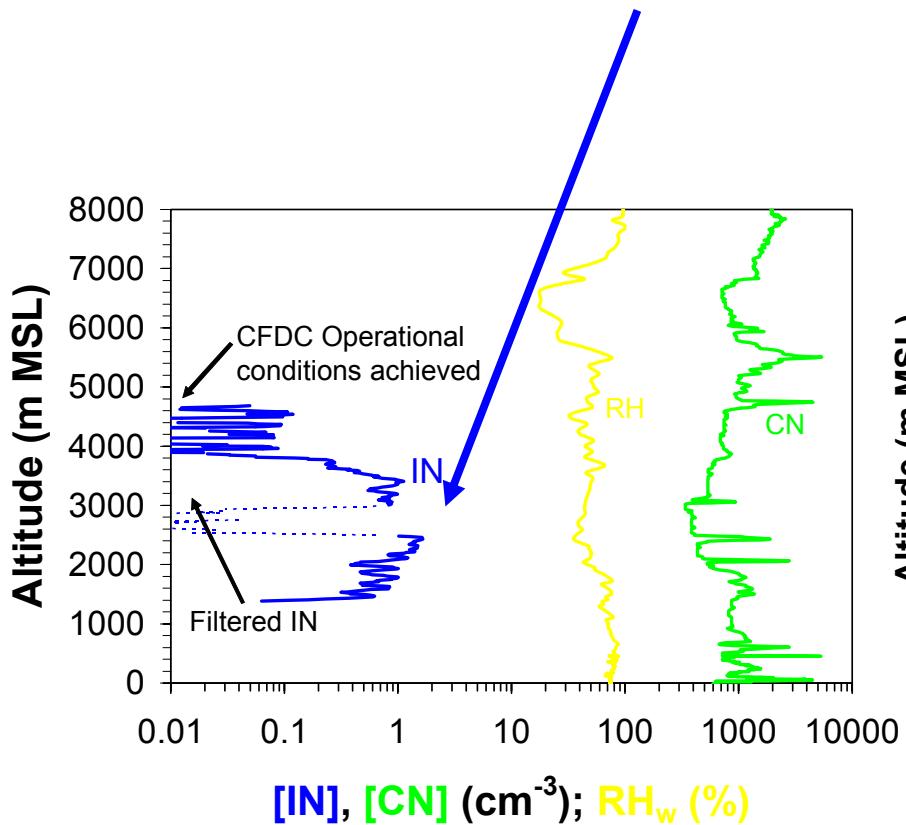
MODIS aerosol optical depth (20-27 July) with HYSPLIT back trajectory for July 29



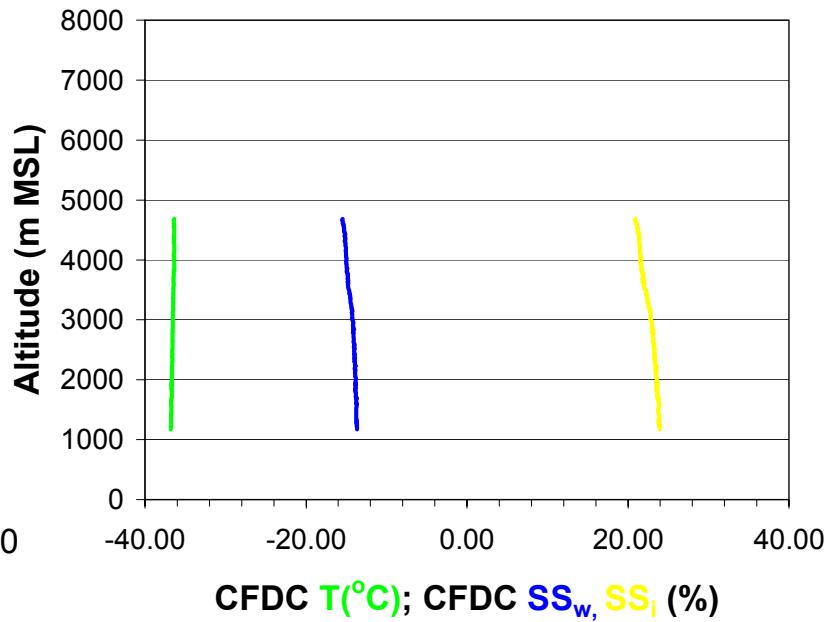
J. Prospero: aerosol chemistry time series at U. Miami



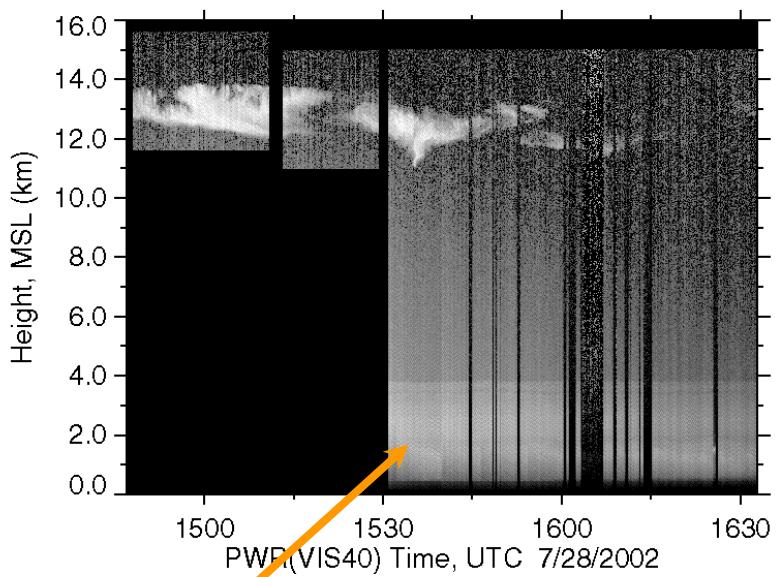
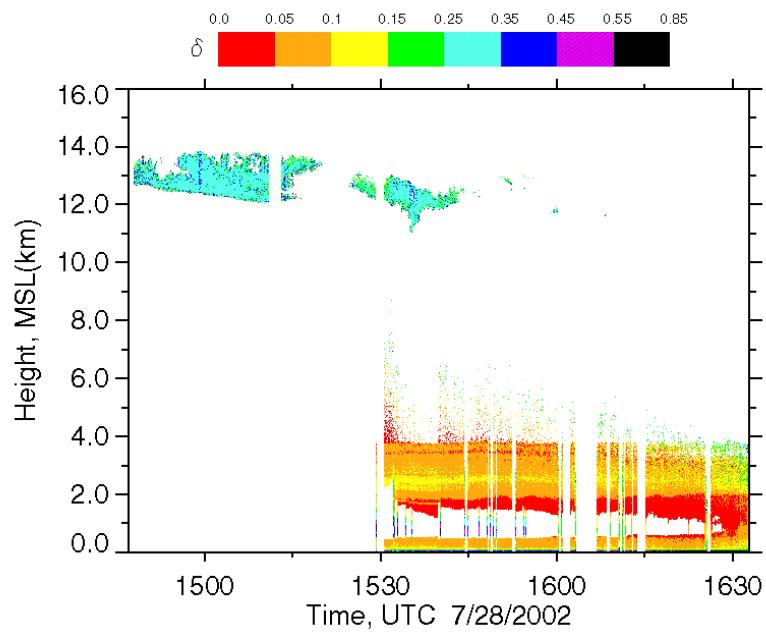
Descent to Key West: July 28



$T = -37^\circ\text{C}$, $\text{SS}_w = 86\%$, $\text{SS}_i = 23\%$
assured heterogeneous ice
nucleation only

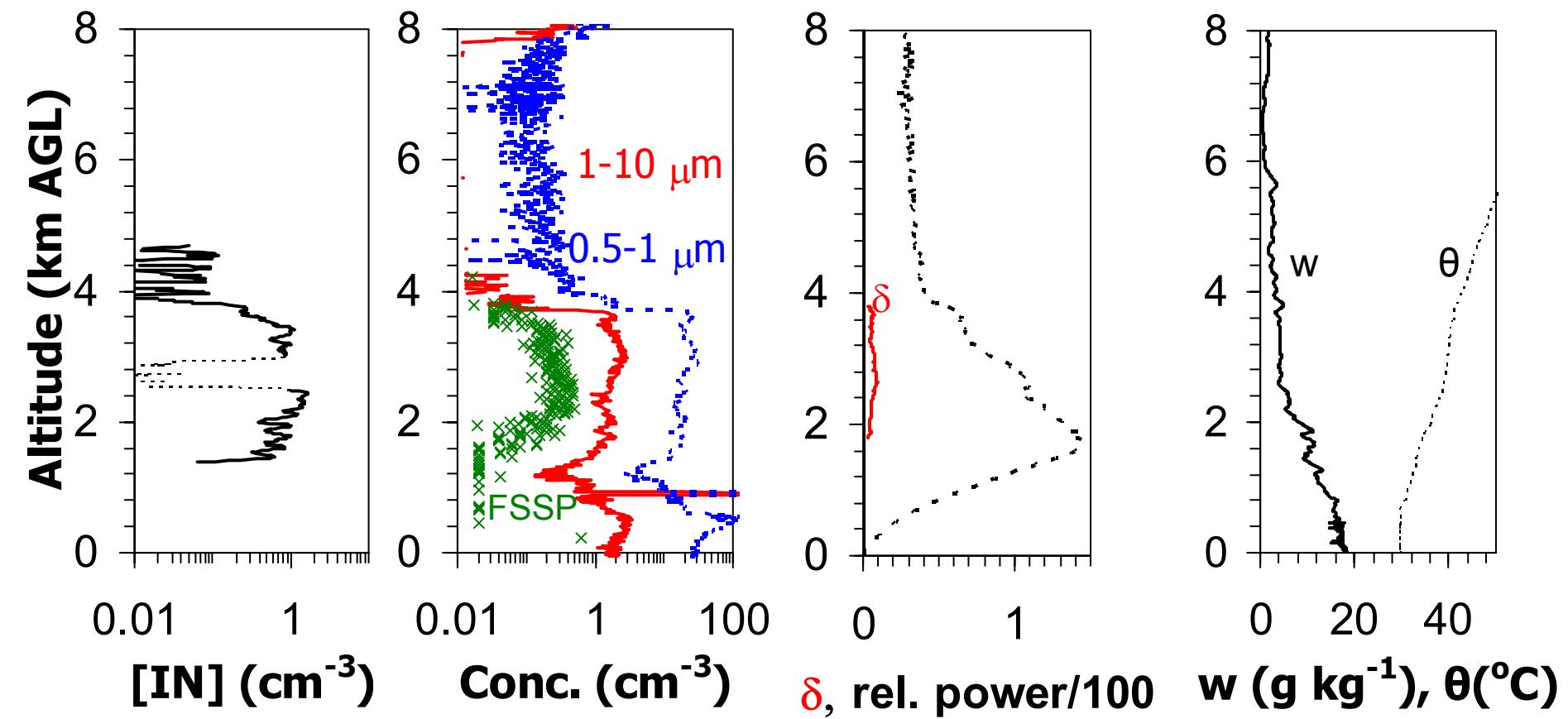


July 28 PDL data example

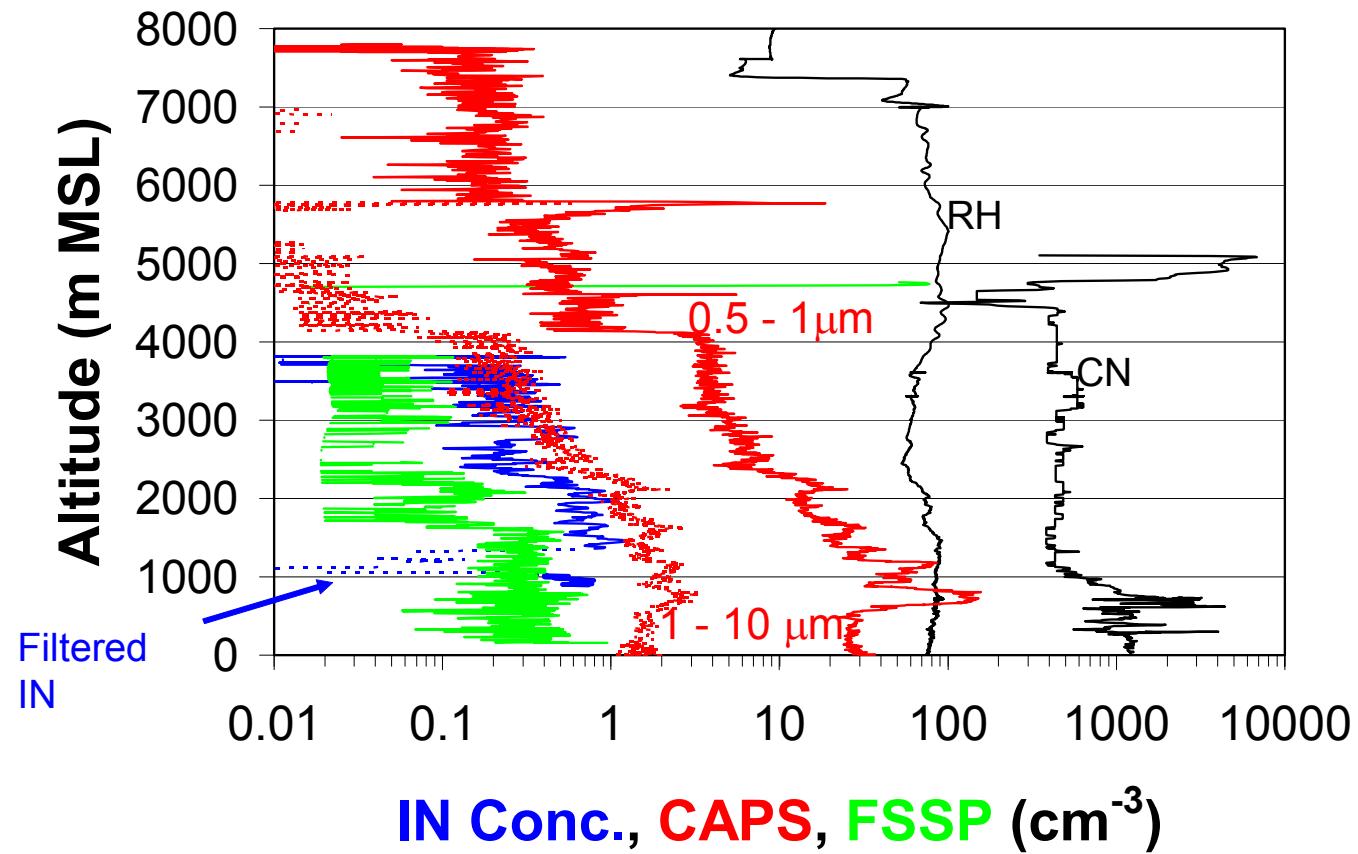


Transported dust layer

July 28, 2002

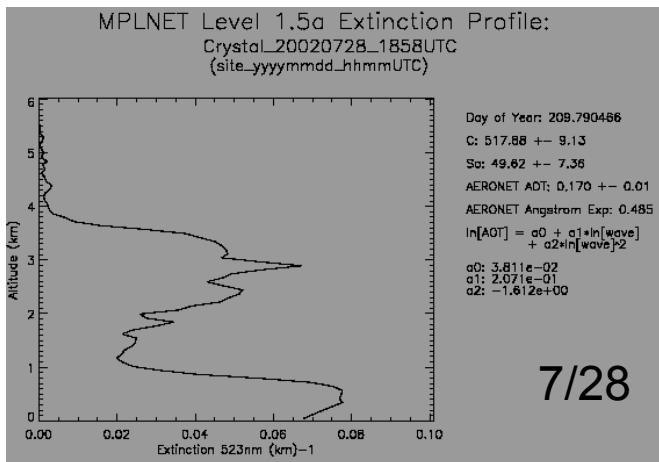


July 29, 2002: Another case (see following presentation by Ken Sassen)

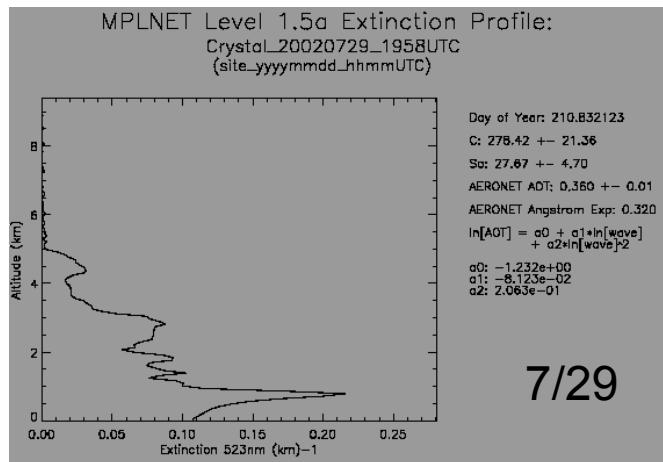


Micropulse Lidar (J. Campbell) extinction profiles (dusty versus less dusty days)

Ang. Exp = 0.485



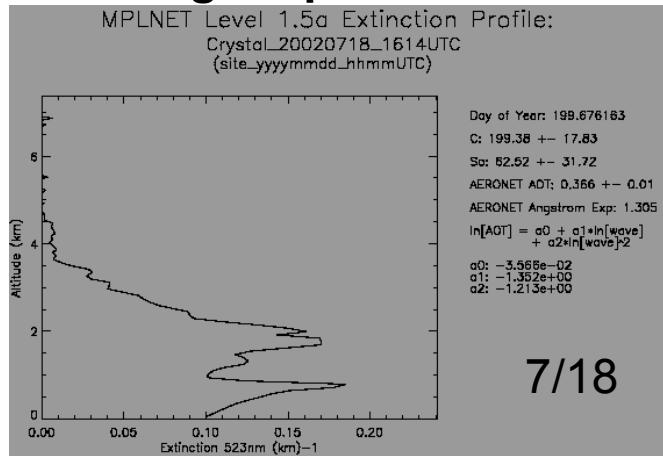
Ang. Exp = 0.320



Suggests July 18 was less dusty. This is consistent with aerosol chemistry data, dust modeling and aircraft (Twin Otter) measured total aerosol volume.

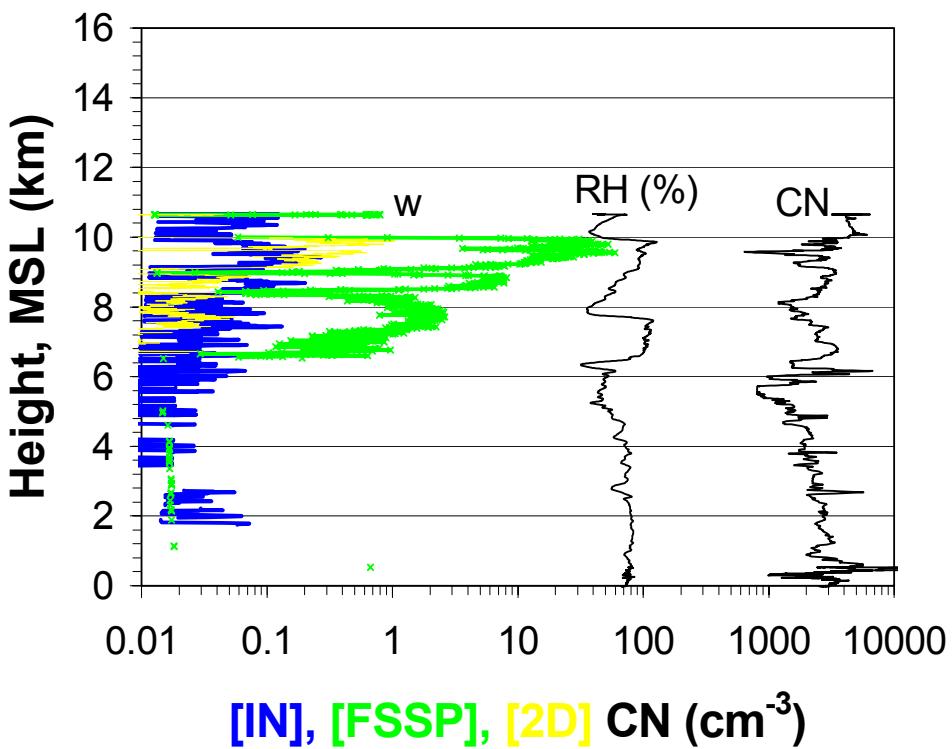


Ang. Exp = 1.386

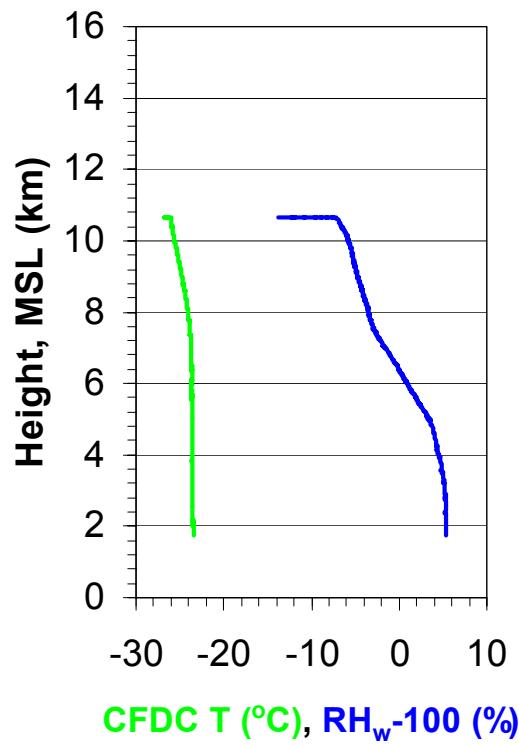


July 18, 2002: Weak dust day

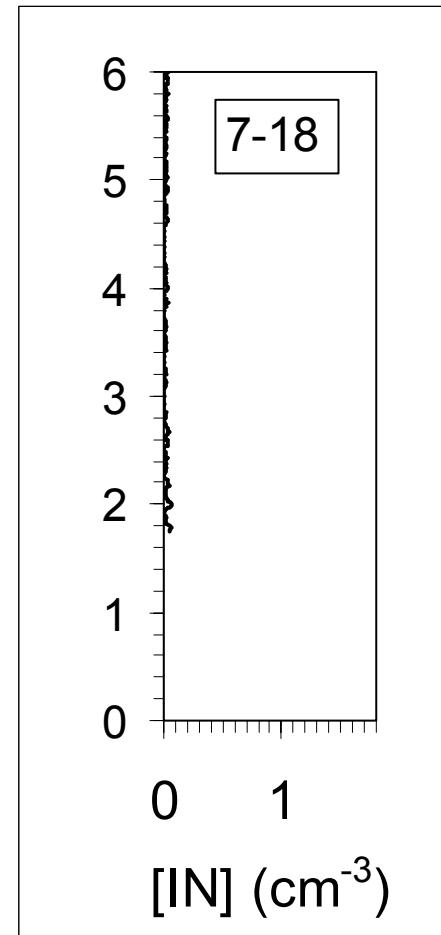
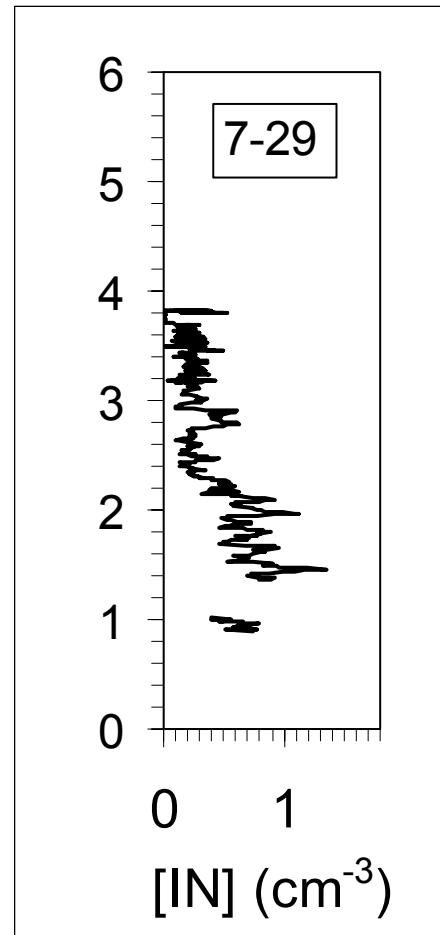
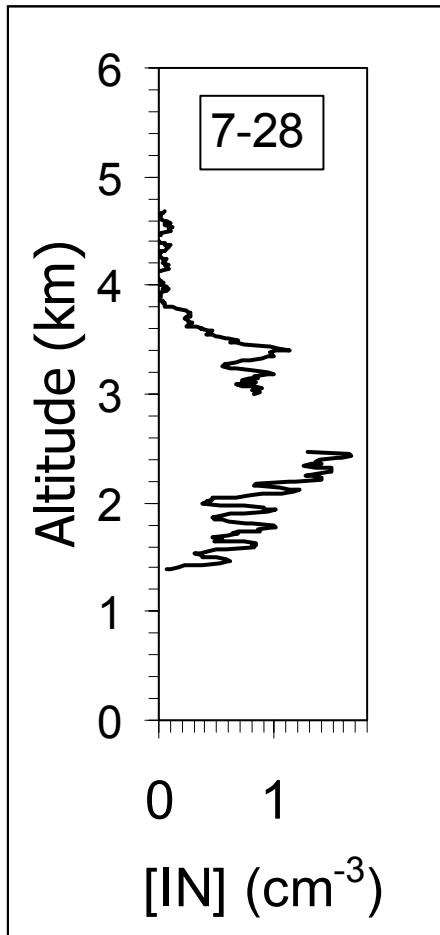
Lower ice nuclei concentrations



Although...different
processing conditions



Summary of three descent soundings of heterogeneous ice nuclei concentrations



What Next?

- **How do dust particles interact with cloud?**
 - Evidence from cumulus updrafts prior to -40°C (cloud penetrations on 7/18, 7/28, 7/29)
 - Evidence in anvils
 - This morning's presentation by DeMott
 - This morning's presentation by Twohy
 - This morning's presentation by Cziczo